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- Digital DC Volts Gauge/w Alarms
- Digital DC Volts Gauge/w Alarms for 3 Battery Banks
- Digital Amps Gauge
- DC Volts/Amps/Amp-Hour Monitors
- AC Volts/Amps/Freq/kW Monitors
- LPG/Petrol Gas Detectors/Alarms
- Bilge Water Alarms/w Stainless Steel Water Sensor
- Intelligent Bilge Pump Controllers/w Stainless Steel Water Sensors
- Intelligent Windlass Controller/Chain Counters
- Digital Fuel Gauges & Fuel Consumption Calculator
- Digital Tank Level Gauges for 1 or 3 Tanks /w Separate Alarms
- Smart 4 step Alternator Regulator
- Marine Security System/w Reliable Intrusion Sensors
- RPM/Engine Hours/Elapsed Time Gauges/w Alarm
- Digital Engine Temperature Gauge/w Alarms
- Digital Oil Pressure Gauge/w Alarms
- Digital Temperature Gauges for 1 or 3 Areas/w Alarms
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- 4 & 8 Channel NMEA Combiners/RS-232 Convertors
- Engine/Exhaust Temp. Monitor & Digital Pyrometer
- NMEA 0183 Remote Data Repeater/w 4 Input Channels

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# CruzPro®



## VAH110



Volts  
Amps  
Amp-Hour Monitor

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## Notes

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# Introduction

The VAH110 is a precision fuel gauge for your battery bank. It tracks your power usage and charge current and tells you how much capacity is remaining in your main house bank at all times.

The VAH110 Battery Monitor provides accurate instrumentation for 3 banks of batteries between 9.5 and 33.0 Volts. It displays voltage for three banks in addition to amps and amp-hours for your main house bank. The VAH110 tracks all current entering and leaving the house bank and applies Peukert's law and charge efficiency factors for maximum accuracy. This information can be used to tell you the optimal time to recharge your battery and when you can stop charging your battery.

The VAH110 has a programmable charge control output that can be programmed to automatically turn on a charge source when the battery reaches a certain state of discharge and turn off the charge source when the battery is charged.

You can set individual Low and High voltage alarms for each battery bank separately and a Low Amp-Hours Remaining alarm. When activated, the built-in 85 dB alarm will sound and the display will flash.

The VAH110 outputs NMEA 0183 serial data of all three battery voltages, amps and remaining battery capacity for the main house bank. If not required, the NMEA 0183 data line can be programmed as an external alarm output. A separate backlight control wire turns the backlights on and off. Five levels of backlighting can be selected and all set-up, calibration constants and alarm values are saved to non-volatile memory.

The VAH110 comes complete with a precision 450 amp shunt and is factory calibrated for that shunt. However, the VAH110 can be programmed to work with 50 to 600 amp 50mV shunts.

## Specifications

**Power supply (Battery 1):** 9.50 to 33.00 VDC, .037 amps nominal

**Battery 2:** 9.50 to 33.00 VDC

**Battery 3:** 9.50 to 33.00 VDC

**Operating temperature:** 32 to 122 F ( 0 to 50 C)

**Size:** 4.3" x 4.3" x 3.5" deep (110 x 110 x 89 mm).

**Resolution:** 0.01 VDC, 0.1A (up to 20.0 amps), 1 amp over 20 amps.

**Accuracy:** Better than +/- 0.05 VDC for volts and 2% +/-1 Amp for amps, front panel adjustable. Uses Peukert's law.

<b>Ranges:</b> Battery 1,2 & 3	-	9.5 to 33.0 VDC
Amps	-	-450 to 450 Amps
Amp-Hours	-	100 to 3000 A/H
Capacity Remaining	-	0 to 100%

**Shunt:** 450 Amp 50mV shunt.

**Alarms:** High, Low Voltage & Low Amp-Hours

**Display:** 4 digit LCD, 5 levels of backlighting.

**NMEA 0183:** \$IIXDR,V1; \$IIXDR,V2; \$IIXDR,V3; \$IIXDR,A;  
\$IIXDR,G

**Charge Control:** Independently programmable lower and upper limits (factory set to 50% and 90% of battery capacity).

seconds (until you hear a long beep). The Amp-Hours Remaining will be reset to the full amp-hour capacity of the battery. The Amp-Hours Remaining will also automatically be reset to the battery capacity if the power is lost or removed from the VAH110.

### Notes and Warnings

a) When setting functions that require you to hold down a key while applying power - turn OFF the power, then hold the key(s) down during and for at least 3 seconds AFTER the power has been applied.

b) A display of "----" means the unit thinks the amp reading is more than -450 amps.

c) It is **important** to run the power ground wire all the way back to the shunt negative as a dedicated wire for the VAH110. Do not share this wire with anything else.

d) The VAH110 Amp-Hours Remaining function is designed to tell you when you should recharge your battery and when you can stop charging your battery while actually using your boat. It is not designed to keep accurate track of battery charge remaining for weeks or months on end while the boat is not being used.

If you keep the battery on a small trickle charger or use a solar panel to keep the battery topped up, the VAH110 will show a slight positive current and the battery Amp-Hours Remaining will slowly rise to show the maximum battery capacity and then remain at that value.

If you are not sure of the amp-hours remaining, fully charge the battery and reset the amp-hour remaining to the battery capacity using one of the techniques shown on page 12.

## NMEA 0183 Sentences

The VAH110 outputs serial data of battery voltages, amps and amp-hours remaining in NMEA 0183 format. The sentences are output in the following formats:

**Volts:** \$IIXDR,U,xx.xx,V,V301\*CS  
\$IIXDR,U,xx.xx,V,V302\*CS  
\$IIXDR,U,xx.xx,V,V303\*CS

**Amps:** \$IIXDR,I,xxxx,A,VAH35,\*CS

**A-H Remaining:** \$IIXDR,G,xxxx,VAH35,\*CS  
\*CS = Check Sum

## Selecting NMEA 0183 or External Alarm Output

The NMEA 0183 serial data line can be programmed to function as an external alarm output

To toggle the data line between NMEA 0183 and External Alarm Output, press and hold down both the ▼ and ▲ keys for 10 seconds (until you hear a long beep). The display will briefly show "dAtA" / or "E-AL" to show you which mode is selected. The new output mode is automatically saved to memory. A 5V signal (10 mA Max.) is output whenever an alarm condition exists and the alarms are enabled.

## Resetting Amp-Hours Remaining

While viewing Amp-Hours Remaining, press and hold the ▲ keys for 10

## Installation

*Before starting the installation, please read this entire section first. Finger tighten the screws that mount the instrument bracket - It is not necessary or recommended to use tools.*

- Drill a 2-1/8" (55mm) mounting hole where you desire to mount the instrument (Figure 1).
- Connect the various wires from Cable 1 and Cable 2 as shown in Figures 2 and Figure 3. **Be sure that the power ground connection (Black wire on cable #1) connects all the way back to the shunt as shown and is not shared with any other equipment.**
- Carefully check all your wiring against figures 2 and 3 and then mount the instrument in the hole. Use only finger tension to tighten the bracket hold-down nuts

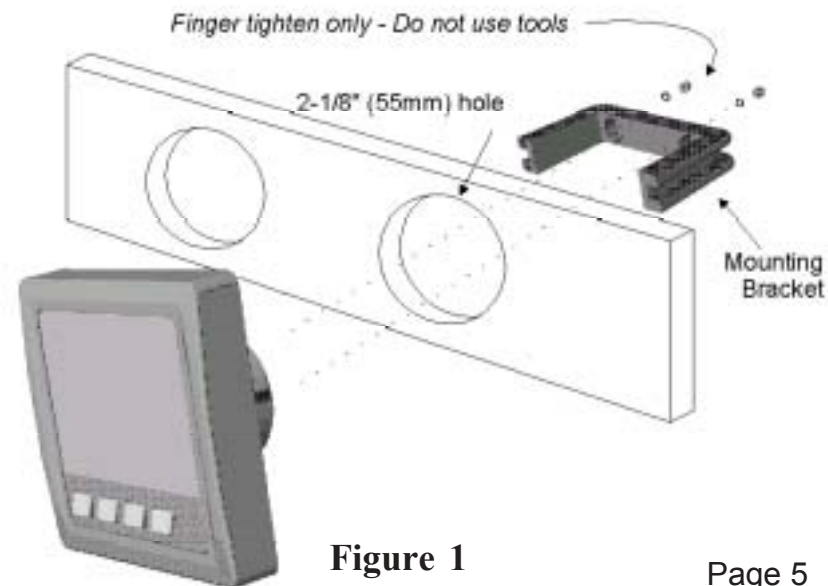


Figure 1

Figure 2

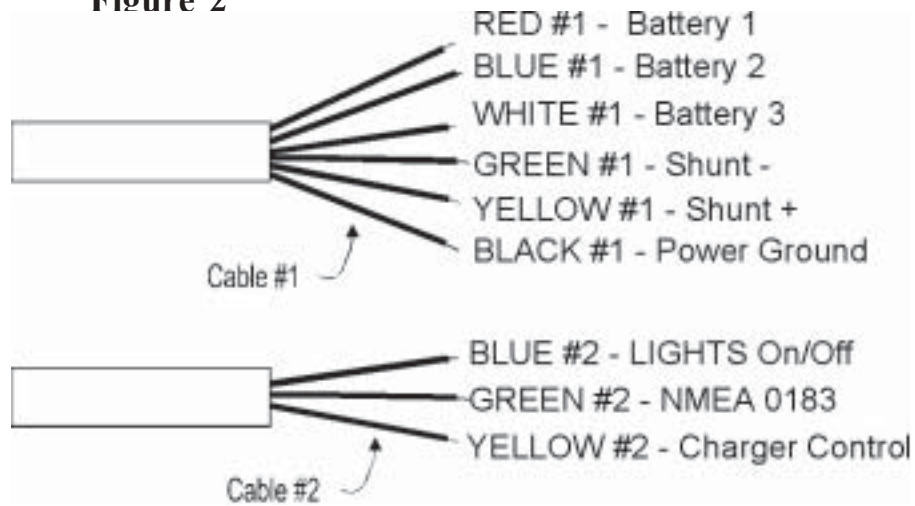
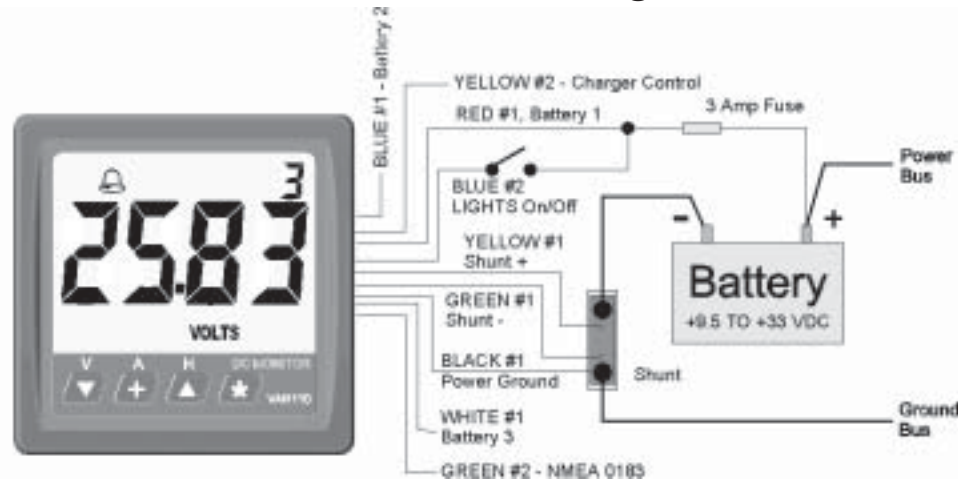


Figure 3



Method “A”: Press the **▲** key to display amps. Then press and hold the **+** key for 10 seconds (until you hear a long beep) to enter into auto-zero mode. The display will flash “AUTO” for one minute while the instrument is finding the best auto-zero value.

Method “B”: This method requires that you perform a short auto-zero by following the directions for Method “A” first. After the short-term auto-zero has been completed, press and hold both the **+** and **\*** keys for 10 seconds (until you hear a long beep) to enter into a 24 hour auto-zero mode. Both the **▼** and **▲** icons on the display will blink simultaneously for 24 hours while the instrument is finding the best long-term auto-zero value.

### Calibrating the Ammeter

To calibrate the ammeter remove power from the instrument then press and hold the **▲** key while re-applying power. Pass a known amount of current through the shunt and use the **▼** and **▲** keys to make the displayed value read correctly. Press the **+** key to save the calibration data to memory. A reasonably high value of current should be used (30 amps minimum) to obtain a reasonably accurate calibration.

### Selecting Full Amps or Tenths Display

You have the option of showing full amps or tenths of an amp when displaying amps. To toggle between the two options, press and hold both the **▼** and **▲** keys for 1/2 second. The choice will automatically be saved to memory. Full amps will always be displayed above 19.9 amps.

To set the upper charge control output limit in percent, press both the **+** and **▲** keys to display Amp-Hours Remaining in percent. Then hold down both the **▲** and **\*** keys for 10 seconds (until you hear a long beep). The upper charge control limit will be displayed in percent. Use the **▼** and **▲** keys to set the desired value. Press the **+** key to save the new value to memory.

To set the lower charge control output limit in percent, press both the **+** and **▲** keys to display Amp-Hours Remaining in percent. Then hold down both the **▼** and **\*** keys for 10 seconds (until you hear a long beep). The lower charge control limit will be displayed in percent. Use the **▼** and **▲** keys to set the desired value. Press the **+** key to save the new value to memory.

#### Calibrating the Voltmeter

The VAH110 is calibrated at time of manufacture, but can be calibrated using the front panel keys. To calibrate the voltmeter, press the **V** key repeatedly until the voltage for the correct battery is being displayed. Then press and hold the **▼** and **\*** keys for 10 seconds (until you hear a long beep) to enter into voltage calibration mode. Use the **▼** and **▲** keys to make the displayed value read correctly. Press the **+** key to save the calibration data to memory.

#### Auto-Zeroing the Ammeter

There are two methods to auto-zero the ammeter. Method “A” is quick and produces a reasonable zero in about one minute. For best long term accuracy of the amp-hour remaining function a longer method “B” auto-zero taking 24 hours can be used. Do not charge or discharge the battery at all when auto-zeroing the ammeter using either method.

## Operation

### Key Functions

The **▼**, **+**, **▲** and **\*** (**V**, **A**, and **H**) keys are used to select what to display, set backlight levels, calibrate volts/amps, turn alarms on/off, set alarms and set/change constants. New information is automatically saved to non-volatile memory.

### Turning Alarms ON/OFF

Press the **▲** key 1/2 second to turn alarms ON. In Voltage mode, the alarm icon will light. Press the **▼** key 1/2 second to turn the alarms OFF.

### Backlight Intensity

Press **+** the key 1/2 second to adjust the backlight level for night viewing. Each time you press the **+** key 1/2 second, the level will get brighter 1, 2, 3, 4, OFF, 1, 2, ... etc. The blue backlight ON/OFF control wire in cable #2 must be switched to +12/24V for the backlights to work.

### Display Volts/Amps/A-H/ A-H% Remaining

Quick press the **V**, **A**, or **H** key to select Battery Voltage, Amps or Amp-Hours Remaining display. Pressing the **V** key repeatedly will step the display through Battery 1, 2, 3, 1, etc. To display the Capacity Remaining (Amp-Hours % Remaining), press the **A** and **H** keys simultaneously.

### Setting High Volts Alarm

Press the **V** key repeatedly until the voltage for the correct battery is being displayed. While viewing Battery Volts, press and hold the **▲** key for ten (10) seconds until you hear a long beep. The High Volts alarm value will be displayed. Use the **▼** and **▲** keys to set the desired alarm value. Press

the **+** key to save the High Volts alarm value to memory.

#### Setting Low Volts Alarm

Press the **V** key repeatedly until the voltage for the correct battery is being displayed. While viewing Battery Volts, press and hold the **V** key for ten (10) seconds until you hear a long beep. The Low Volts alarm value will be displayed. Use the **V** and **▲** keys to set the desired alarm value. Press the **+** key to save the Low Volts alarm value to memory. Below 9.50 volts, the Low Volts alarm value will display “OFF”.

#### Setting Low Amp-Hours Alarm

Press the **H** key to view to view Amp-Hours Remaining. While viewing Amp-Hours Remaining, press and hold the **V** key for ten (10) seconds. You will hear a beep and the Low Amp-Hours alarm value will be displayed. Use the **V** and **▲** keys to set the desired alarm value. Press the **+** key to save the Low Amp-Hours alarm value to memory.

#### Changing Battery Capacity

Remove power from the instrument. Press and hold the **H** key while applying power to the VAH110. The Battery Capacity (in Amp-Hours) will be displayed. Use the **V** and **▲** keys to change the Battery Capacity value to the new desired setting. Press the **+** key to save the new Battery Capacity to memory.

#### Changing Charge Efficiency

The Default Charge Efficiency is 80% (meaning you get back 80% of what you put into the battery). To change it, press and hold both the **V** and **▲** keys and apply power to the VAH110. Charge Efficiency % is displayed. Use the **V** and **▲** keys to change it. Press the **+** key for 1/2 second to save the new value to memory

#### Changing Peukert's Exponent

Peukert's Exponent relates how efficiently you can draw current from a battery. Because of inefficiencies, the faster you drain the battery, the smaller it appears to be. The default Peukert's Exponent is 1.25, which is typical for many batteries. To change it, remove power from the instrument. Press and hold the **+** and **▲** keys while re-applying power to the instrument. Peukert's exponent will be displayed. Use the **V** and **▲** keys to set the desired value. Press the **+** key to save the new value to memory. If your battery seems to discharge faster than what the VAH110 is telling you, try increasing Peukert's Exponent slightly. Lower the exponent if the reverse is true. The correct setting will depend upon how your battery was manufactured and it's age, etc.

#### Changing Automatic Charge Control Limits

The VAH110 can be programmed to turn a charger on/off automatically when required, depending on Amp-Hours Remaining. The factory default value is to switch the charge source on when Amp-Hours Remaining drops down to 50% of battery capacity and switch off when Amp-Hours Remaining is back up to 90% of battery capacity. The yellow Charger Control wire will sink 100mA at up to 33 VDC when activated. This line is protected with a transient rejection diode and intended to drive a 12 or 24V relay.